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PENSOFT

Dario kajal Britz & Kullander, 2013 (Percomorpha, Badidae): the first documentation of the genus *Dario* Kullander & Britz, 2002 from Bangladesh

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Abstract
We document for the first time in Bangaldesh *Dario kajal* Britz & Kullander, 2013, a little-known miniature badid species originally described from the Jaintia Hills, India. We provide records of 8 specimens from 3 localities, of which, 2 are in the Meghna basin. Our finding also confirms its distribution from the Brahmaputra drainage, about 300 km southwest from the type locality. The genus *Dario* Kullander & Britz, 2002 was previously unknown from Bangladesh.

Key words
Brahmaputra, freshwater fish, new record, range extension.

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Introduction

The Badidae is a modest family of small freshwater perches consisting of 31 valid species belonging to 2 genera: *Badis* (Hamilton, 1822) (24 spp.) and *Dario* Kullander & Britz, 2002 (7 spp.) (Kullander and Britz 2002, Dahanukar et al. 2015, Nelson et al. 2016, Britz et al. 2018, Fricke et al. 2018). Commonly known as chameleonfishes, the family has an oriental distribution and includes some of the smallest species of all percomorph fishes (Kullander and Britz 2002, Collins et al. 2015, Nelson et al. 2016, Betancur-R. et al. 2017). The distribution of the badids encompasses South and Southeast Asia, from southern India on the west, the Himalayan foothills of Nepal and India on the north, the Ganges floodplain centrally, and east as far as the Mekong drainage in Thailand and Laos (Kullander and Britz 2002, Nelson et al. 2016).

In Bangladesh, the badids are limited to 2 *Badis* species (Mahalder 2015, Mustafa 2015). The type species, *Badis badis* (Hamilton, 1822), with a sub-continental presence, is found throughout the country but in scanty number (Rahman and Chowdhury 2007, Mustafa 2015). The discovery of more abstruse *Badis chittagongis* Kullander & Britz, 2002, on the other hand, arose from the hill streams of the Matamuhuri River drainage of the Chittagong Hill Tracts (Kullander and Britz 2002, Mahalder 2015). This species, later on, appears in no further works and is considered endemic to Bangladesh.

Until now, the genus *Dario* has not been reported from Bangladesh. However, almost all species of the genus occur in just 3 river systems in South Asia (Britz

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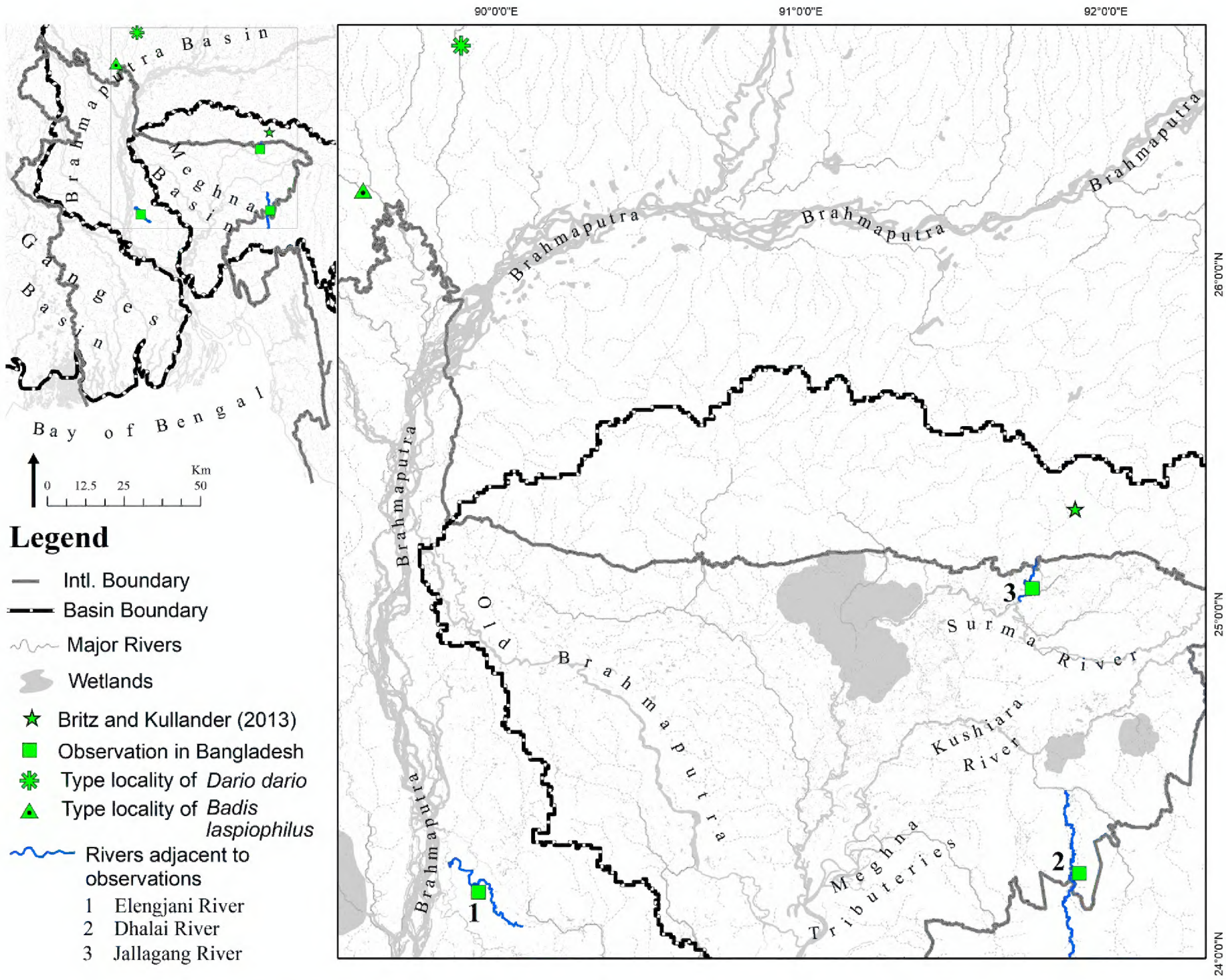

Figure 1. Localities of *Dario kajal*. Squares indicate the localities found in the study; star denotes type locality described in Britz and Kullander (2013); asterisk remarks type locality of *Dario dario*; triangle denotes type locality of *Badis laspiophlius*.

and Ali 2015). Except the South Indian *D. huli* Britz & Ali, 2015, *D. urops* Britz, Ali & Philip, 2012, and *D. neela* Britz, Anoop & Dahanukar, 2018, the Brahmaputra drainage in northern India is represented by *D. dario* (Hamilton, 1822), the Ayeyarwaddy drainage in Myanmar and China by *D. hysginon* Kullander & Britz, 2002 and *D. dayingensis* Kullander & Britz, 2002 respectively, and the Meghna drainage in northeast India has reports of *D. kajal* Britz & Kullander, 2013 (Kullander and Britz 2002, Britz and Ali 2015).

We report the genus *Dario* for the first time from Bangladesh. We record 3 new localities for *D. kajal* from the Brahmaputra system, which extends southward the known geographic range of this recently named species.

Methods

Six live specimens of *Dario kajal* were collected from a canal of the Elengjani River (24°10.29′ N, 089°58.67′ E; Locality 1) on March 19, 2018. On further note, 1 live specimen was encountered from a roadside ditch nearby the Dhalai River (24°14.87′ N, 092°01.53′ E; Locality 2) on December 28, 2015 and another 1 from the Jallagang River (24°09.53′ N, 092°01.53′ E; Locality 3) on December 29, 2015 (Fig. 1). Geographically and administratively, the Elengjani River is a distributary of the Brahmaputra flowing through Tangail, a district of central Bangladesh. Localities 2 and 3 are both in northeast Bangladesh. Locality 1 has a degraded habitat faced with encroachment and heavy sand extraction, as it is also the scenario of the Elengjani River. Locality 2 on the Dhalai River, which traverses the district of Moulvibazar, is a transboundary tributary of the Kushiara River, which is a major feeder of the Meghna. Locality 3 at Jallagang River, in the district of Sylhet, is another transboundary waterway with a direct connection to the Myndtu River of India. The Dhalai and Jallagang rivers represent torrential, stony, shallow aquatic habitats. The latter is a popular tourist spot and has several stone quarries.

Specimens from the Locality 1 were caught with a hand-operated push net. We acquired specimens from the other 2 localities as by-catch in an artisanal lift net. Local avid youth and fishermen aided our effort. Six voucher specimens from the Locality 1 have been preserved in 10% formalin and deposited in the Department of Zoology, University of Dhaka (DU-FS). Measurements were taken using digital calipers with the aid of a stereomicroscope. The geographic coordinates of our records use the WGS84 geodetic datum.

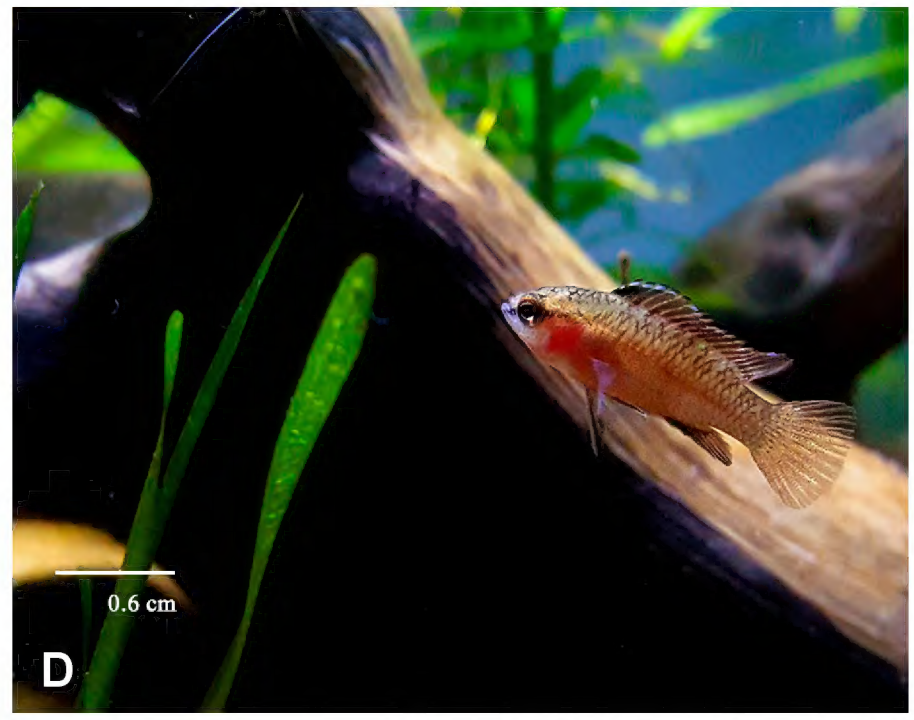

Figure 2. *Dario kajal* from Bangladesh. **A.** Full close-up of a male specimen, 17.5 mm standard length (DU-FS-190318-13-III); from Bangladesh, Dhaka division, Tangail district, Locality 1, the Elengjani River, a distributary of the Brahmaputra River, lateral view, photograph by Muntasir Akash. **B.** General aspects of an adult male, illustration by Tania Zakir. **C.** Preserved state of DU-FS-190318-13-III, photograph by Muntasir Akash. **D.** Submissive male with view of the containment surroundings, 16.5 mm standard length (DU-FS-190318-13-IV); from Bangladesh, Dhaka division, Tangail district, Locality 1, the Elengjani River, a distributary of the Brahmaputra River, lateral view, photograph by Muhammad Mushfiqus Salehin.

Results

Class Actinopterygii
Clade Percomorpha
Order Anabantiformes
Family Badidae
Genus *Dario* Kullander & Britz, 2002

***Dario kajal* Britz & Kullander, 2013**
Figure 2

New records (Fig. 2). Bangladesh: Dhaka division: Tangail district: Elengjani River: Locality 1 (24°10.29′ N, 089°58.67′ E), M.M. Salehin & M. Akash coll., 19 March 2018, canal attached to the river (5 males, 1 female, DU-FS-190318-13-I-VI). Bangladesh: Sylhet division: Moulvibazar district: Dhalai River: Locality 2 (24°14.87′ N, 092°01.53′ E), M. Akash & T. Khan coll., 28 December 2015, roadside ditch (1 individual, unsexed, not retained; photographic voucher number DU-FS-ph-281215-kajal). Bangladesh: Sylhet division: Sylhet district: Jallagang River: Locality 3 (24°09.53′ N, 092°01.53′ E), M. Akash coll., 29 December 2015, roadside ditch (1 individual, unsexed, not retained).

Identification. We identified our specimens as *Dario kajal* based on morphological observations. Like all other species of *Dario*, *D. kajal* has an overall beige color with a reddish hue. The dominance of red or reddish tint on body, the small body size, the caudal fin without any curve, no visible lateral line and longer dorsal and pectoral fin rays distinguish *Dario* from *Badis* (Kullander and Britz 2002). *Dario kajal* is different from all other congeners owing to the conspicuously uniform black stripe that runs through the orbit in line without forming an angle (Fig. 2). Kullander and Britz (2002) reasoned the etymology of the epithet "kajal" is derived from the Bengali word meaning "black eyeliner", especially that used by the women in India and Bangladesh, in allusion to this species' prominent orbital stripes. In *D. dario* and *D. urops,* this line is visibly slanted from its preorbital to postorbital section. *Dario urops* is also marked with a horizontal suborbital band. An orbital band is completely absent in *D. hysginon, D. dayingnsis*, *D. huli*, and *D. neela. Dario kajal* lacks any form of caudal blotch (present in *D. urops*, *D. huli*, and *D. neela*) (Kullander and Britz 2002, Britz et al. 2012, Britz and Kullander 2013, Britz and Ali 2015).

The coloration of males and presence of bars on the body flanks in *Dario* spp. are important key differentiating traits. The upper half of male *D. kajal* is ornamented with 5 faint double-bar saddles connected to the dorsal fin base along with 1 partially complete double bar on the peduncle. The saddle series extends ventrally and vertically toward 3 scales. In *D. hysginon* and *D. dayingensis*, the body is uniformly colored, with the bars absent (Kullander and Britz 2002). In *D. urops*, complete bars are present only on the posterior half, and in *D. dario,* a row of 7 iridescent blue vertical bars flanks the body, whereas a row of 8 black bars distinguishes *D. neela*. In further contrast with *D. urops,* dorsal fin lappets project visibly beyond the tip of the spine in *D. kajal* (Kullander and Britz 2002, Britz et al. 2012, Britz and Kullander 2013). *Dario neela*, which shares with *D. kajal* a similar lappet-projection beyond the spinous tip, has wide iridescent blue bars that are conspicuously present on paired and unpaired fins; these fin bars are absent in *D. kajal* (Britz et al. 2018). We observed 14 spinous rays and 6 soft rays on the dorsal fin of our specimens and 3 spines on the anal fin along with 6 soft rays (Fig. 2). Morphometric measurements of 2 male specimens are provided in Table 1. *Dario kajal* is small, reaching 21 mm (standard length) in our specimens).

The preorbital and postorbital stripes were black in our specimens. The outer edges of spiny part of the dorsal and anal fin were rimmed with white, and a white border on dorsal fin was lined by a narrow but easily visible black band. On the leading edge of pectoral, this white line was most prominent.

In live specimens kept in well-maintained aquarium confinement, we saw the bar saddles turning orange-brown from black. The white rim on the pectoral fin had a faint bluish tinge. The red coloration, while intense, was not as strong as in *D. dario*. We also observed green iridescence on the operculum and anteriorly on the flank of our specimens (Fig. 2).

Table 1. Selected morphometric characteristics of 2 specimens of *D. kajal* from Bangladesh.

	DU-FS-190318-13-I	DU-FS-190318-13-II
Standard length (SL) in mm	21	19.4
In percent of SL		
Head length	32.6	31.7
Snout Length	6.9	6.2
Eye diameter	11.3	11
Pre dorsal distance	30.0	29.6
Dorsal base length	41.2	39.5
Body depth	32.8	31.3
Pectoral length	18.9	18.3
Pelvic length	32.9	31.4
Pelvic to anal distance	33.8	32.2
In percent of head length		
Snout length	18.8	18.3
Eye diameter	35.6	34.9

Discussion

Britz and Kullander (2013) predicted the presence of *D. kajal* in the rivers of Bangladesh. This species was the first of its genus to be recorded from the Meghna basin. The type locality of *D. kajal* is Seinphoh stream, a tributary of the Myndtu River, India (Britz and Kullander 2013). This river enters Bangladesh and joins the Meghna drainage system. In fact, one of our new records (Locality 3) is only about 40 km downstream from type locality and is directly connected to the Myndtu River. Localities 2 and 3 share similar habitats to the type locality; they exhibit turbidity, with little aquatic vegetation.

Our record of *D. kajal* from Locality 1 in the Elengjani River is of special importance, as it is more than 300 km from the type locality and in an entirely separate drainage system. This is the first time that this species has been reported from the Brahmaputra drainage. The Elengjani River branches off of the Brahmaputra, a slow-flowing murky river whose current is dependent on monsoon rains. This river is of the most anthropogenic usage in comparison to other localities, and both floating and submerged aquatic vegetation is abundant.

The presence of *D. kajal* in the Brahmaputra drainage is likely owing to the lack of a geographic barrier and the torrential overflow of rivers. The paleo-route of the Brahmaputra, the Old Brahmaputra river networks bounded by the high-terraced land of the Madhupur Tract, demarcates the boundary between the 2 basins, but several rivulets connect to the Ganges-Brahmaputra confluence. *Dario kajal* might have expanded its range using these river passages. Because of its small size and the possibility of being overlooked, *D. kajal* might also be present west of the Brahmaputra as well as in the Teesta tributaries. With a large distribution range, the populations of *D. kajal* have chance to form a species complex.

Miniaturization, according to the definition in Weitzman and Vari (1988), is represented in badids by 5 species, all from the drainages east of the Ganges. All are species of *Dario*, except for *Badis laspiophilus* Valdesalici & van der Voort, 2015 (Britz and Kullander 2013, Britz and Ali 2015, Valdesalici and van der Voort, 2015). Our new records make *D. kajal* the third miniature badid in the tributaries of the Brahmaputra; the other two miniature species are *D. dario* and *B. laspiophilus*, with their type localities about 70 km and 20 km from the place where the Brahmaputra flows into Bangladesh (Fig.1; Kullander and Britz 2002, Valdesalici and van der Voort 2015). In accordance with Ruber et al. (2004) and Britz and Kullander (2013), the discovery of *D. kajal* in another basin gives even further unique insight to the distribution and speciation pattern of the genus *Dario*. Along with the likelihood of the presence of *D. dario* and *B. laspiophilus*, increased sampling effort might reveal several more badids in sympatric association across the entire northern half of Bangladesh.

Finally, for a diminutive, secretive and easily-overlooked group, we conjecture that *Dario* and many *Badis*

to-be-described from the country are very likely to be well distributed throughout the 2 intricate tributary systems of the Brahmaputra and the Meghna.

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Authors' Contributions

MA and MARH apprehended the plan and identified the species. MA and TK collected the data. TZ prepared the manuscript and dealt with the measurements. Each of the authors reviewed, finalized and approved the manuscript.

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